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INTO THE  
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GRAVEL.

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RESEARCHES  
INTO  
THE CAUSES, SYMPTOMS, &c.  
OF  
*GRAVEL.*

---

INTRODUCTION.

WHEN a person voids with his urine, either habitually or at intervals, sandy particles usually of a reddish colour, or small calculous concretions, variable in size and number, he is affected with *gravel*.

This disease, which has existed from the most early ages, generally affects persons who have passed the middle period of life : it more particularly attacks those of a full habit of body, who indulge much in the use of wine and a luxurious diet, and who take but little active exercise.



There are some individuals affected with gravel, who suffer no pain nor inconvenience from it, except occasionally a slight sensation of heat at the time of passing the urine; but such instances are by no means common; it more frequently happens that the expulsion of the sandy particles or calculous concretions is accompanied with slight rigors; pain about the back and loins; and general uneasiness. In some cases the patient is attacked with fever, and he suffers acute pain in the loins and along the course of the ureters; the urine becomes suppressed, or is voided mixed with blood. These symptoms are accompanied with restlessness, and a disordered state of the bodily functions in general; and continue until after the expulsion of one or more calculi; which in some instances does not take place until several days have elapsed.

When gravel, accompanied with these symptoms, appears in paroxysms after but short intervals, or continually exists, it is not only a painful disorder, but



tends also to shorten the life of the patient.

A long continuance of this complaint leads also to the production of many diseases, which it is difficult to cure or even to relieve. Such are inflammation of the kidneys; stone in the pelvis of the kidneys or ureters; stone in the bladder, for which the operation of lithotomy is merely a palliative, since there is always a tendency to the formation of new calculi; frequent retention of urine; abscesses and fistulæ in the perineum, &c.

Notwithstanding the frequency of its occurrence, and its serious consequences, gravel has been but slightly noticed in systematic works on medicine and surgery; in particular treatises on the diseases of the urinary passages, it has been but very imperfectly discussed, and it has not to my knowledge ever been the professed object of a work.\*

\* Dr. Marcet, who a short time since published an "Essay on Calculous Disorders," has not considered it necessary to separate the history of gravel from that of other calculous concretions in the urinary passages.



Having made some observations respecting gravel which tend to elucidate the causes of that disease, and point out a mode of treatment more mild and efficacious than that hitherto employed, I have considered that I should render some service to science and to persons afflicted with this malady, in publishing the result of my researches respecting it. My intention is to write an essay on the manner in which the chemical knowledge of the present day, and the results of physiological experiments conducted with care and attention, may be applied to the practice of medicine; to point out the ill consequences which have and may yet ensue from the abuse of these acquirements; and to show that the proper use of them, that is, when they are confined to what is evident, may, and has really been, productive of the greatest advantages.

Men of science will judge if the theory I advance be correct; and medical practitioners, if the mode of treatment I propose is beneficial,



## CHAP. I.

ON THE NATURE OF THE CALCULI AND SANDY  
PARTICLES VOIDED BY PERSONS AFFECTED  
WITH GRAVEL.

THE knowledge of the composition of the substances which constitute calculous concretions and sandy particles voided by persons affected with gravel, is entirely due to the late discoveries in chemistry, and to the perfection to which analytical investigation has been brought by modern professors of that branch of science, we may indeed say, by our contemporaries. Van Helmont, the most inclined of all the chemists of the seventeenth century, to apply the principles of his science to the explanation of the phenomena of health and disease, could only, even with his penetrative imagination, compare the formation of gravel in the urine, to the depo-

sition of tartar from wine. This notion, but trifling, indeed, as relative to science, must be considered of great importance, when we compare it with the ridiculous reveries advanced by his predecessors.\*

It was Scheele who, in the year 1776, made us acquainted with the true nature of the concretions voided with urine: he showed that they were principally formed of a particular acid, which he termed *lithic*, and proved it to be an immediate principle peculiar to urine.

Since that period, the labours of Wollaston, Fourcroy, Vauquelin, Brande, and Marcet, have fully confirmed the discovery of the illustrious Swedish chemist, and have furnished us with many other important facts relative to this subject: it has, for instance, been ascertained, that besides the lithic acid

\* Paracelsus gave the barbarous term *Duéléch*, to the matter of which calculi are composed; he believed it formed of animal resin, hardened by the spirit of urine. It is, however, remarkable, that he compared this substance to that of gouty concretions; a fact which was a long time afterwards proved by Dr. Wollaston.



of Scheele, now termed, after Dr. Pearson, *uric*, certain species of gravel, contain a small quantity of oxalate of lime; and in some cases, which are, indeed, very rare, the concretions are formed entirely of phosphate or oxalate of lime; and when they have remained long in the kidneys, they become covered with a thin layer of phosphate of lime and magnesia. Very lately, M. Gaultier Claubry, an intelligent young chemist, has found four calculi in the kidney of a man, formed of a nucleus of oxalate of lime, and an exterior layer of uric acid. Dr. Marcet, in the work he has lately published, mentions two cases in which stones were voided, that were formed of cystic oxide, and another, where a concretion expelled from the urethra was of a fibrinous nature.

I have myself frequently analysed the calculous concretions voided by patients affected with gravel, and in every instance, above thirty in number, found them composed of uric acid, united with a small proportion of animal matter.

Thus, overlooking, or considering as exceptions, the very rare cases where gravel has been found wholly, or in part, composed of oxalate and phosphate of lime, cystic oxide, &c. we may state that this substance is constantly composed of uric acid united with a small proportion of animal matter, which is probably the mucus that lines the urinary passages.

Such being the composition of the deposit from the urine of patients affected with gravel, it is necessary that the acquisition we have made respecting the properties of uric acid, and the circumstances which determine its presence in the urine, should be next considered. This investigation will naturally lead us to a knowledge of the causes of gravel.



## CHAP. II.

OF URIC ACID, ITS PROPERTIES, AND THE CIRCUMSTANCES WHICH DETERMINE ITS PRESENCE IN THE URINE.

THE urine of man, and that of all animals which feed principally on aliments containing a considerable proportion of azote, such as flesh of all sorts, fish, eggs, &c., contains uric acid. This appears always to exist in the urine when it has the power of reddening the tincture of turnsole. The proportion of it varies with that of the aliments containing azote. When animal food is exclusively taken, the urine is abundantly charged with uric acid, and may indeed be entirely formed of it, as is proved by the results of the experiments of Vauquelin and Wollaston, on the urine of some species of birds.

If, on the other hand, animals feed

solely on vegetables, the urine does not furnish the smallest traces of uric acid.

From a series of experiments, of which I last year presented an account to the academy of sciences, I discovered that if a carnivorous animal be deprived of all food containing azote, and is fed with sugar, gum, or oil, substances known to be nutritive, but which do not contain azote in their aliments, his urine at the end of three or four weeks will be entirely devoid of uric acid. This is what took place in the following experiment which I extract from my memoir.\*

A small dog, three years old, fat and in good health, was confined to white sugar alone for food, and distilled water as drink, of both which he was allowed to take as much as he chose.

For seven or eight days he appeared to do very well with this new diet; he was active and docile, and ate and drank

\* A Memoir on the Nutritive Properties of Substances which do not contain Azote; read to the Academy of Sciences at Paris, August 18th, 1816.



with his usual avidity. In the second week he began to get thin, although his appetite continued good, and he ate from six to eight ounces of sugar in twenty-four hours. His alvine evacuations were neither frequent nor copious; but his urine was very abundant in quantity.

He became still more thin during the third week, his strength diminished, he lost his activity, and his appetite was much diminished. At this time there appeared, first on one eye and afterwards on the other, a small speck of ulceration on the centre of the transparent cornea, which increased rapidly; and at the end of a few days, had become more than a line in diameter; the depth of it increased in the same proportion; soon afterwards the cornea became entirely perforated, and the humours of the eye were evacuated externally. This singular phenomenon was accompanied with a copious secretion from the glands of the eye-lids.

The emaciation continued to increase, and the strength of the animal to diminish.

nish ; and although he ate three or four ounces of sugar daily, he became so weak that he could neither chew nor swallow ; all other motions were, for stronger reasons, impossible. He died on the thirty-second day of the experiment. I opened his body with all the necessary precautions. A total want of fat was the first thing observed ; the muscles were hardly one-sixth of the ordinary size ; the stomach and intestines were also much diminished in volume, and strongly contracted.

The urinary and gall-bladders were both distended with the fluids proper to them. I requested M. Chevreul to examine their contents : he found them to possess all the characters of the bile and urine of herbivorous animals ; that is, *the urine, instead of being acid, as it is in all carnivorous animals, was sensibly alkaline, and it did not afford any traces of uric acid, or of the phosphates.* The bile contained a considerable proportion of pyeromel, a characteristic of the bile of the ox, and of herbivorous animals in



general. The excrements, which were also examined by M. Chevreul, contained but very little azote, of which they ordinarily furnish a considerable quantity.

We deduce from this and the preceding facts, a conclusion of great importance regarding the subject on which we are now engaged, which is, that there exists an evident relation between a certain diet and the presence of uric acid in the urine; or, in other words, that uric acid only exists when animals are fed with substances containing azote.

Until very lately, we had no exact information respecting the chemical composition of uric acid; it was only known that it contained a considerable proportion of azote, but this proportion had not been strictly determined; it is to M. Berard, of Montpellier, that we are indebted for a recent analysis of this acid. According to this young and ingenious chemist, a hundred parts, by weight, consist of —

Azote	-	-	-	39.16
Carbon	-	-	-	33.61
Oxygen	-	-	-	18.89
Hydrogen	-	-	-	8.34
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				100.00
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The same chemist has made a remark, which may be useful in the treatment of gravel; which is, that uric acid has a very feeble *capacity for saturation*, so that it forms salts that differ from it in respect to solubility, when it comes in contact with very small quantities of bases susceptible of combination with it.

Uric acid possesses several properties, a relation of which is here indispensable. When in a state of purity, it is solid, of a pale-yellow colour, heavier than water, without taste or odour, and does not show any very evident action on the tincture of turnsole; it is not decomposed on exposure to the air; and what should be particularly noticed, is, that water at the temperature of from 65° to 70° Fah-



renheit, only dissolves the  $\frac{1}{1725}$ th of its weight; at the boiling heat it dissolves the  $\frac{1}{1150}$ th, and deposits the superabundant quantity on cooling, in the form of small flakes. Uric acid is insoluble in alcohol; the salts which it forms with salifiable bases are soluble in any considerable degree, only as the bases themselves possess that property, and as they may be in excess. Nearly all the acids are capable of decomposing them. Indeed, if an excess of acid, however weak, be added to a solution of alkaline suburate, the uric acid is immediately precipitated.\*

Such are the circumstances respecting uric acid, which it is important we should bear in mind; it will soon be evident, that it is on those, in a great measure, that our opinions on the origin and treatment of gravel are founded.

### *Remarks on Cystic Oxide.*

Although gravel and urinary calculi

\* Vide Thenard's Treatise on Chemistry, vol. iii. page 455.

are but very rarely formed of cystic oxide, and for this reason we might neglect to notice it on this occasion, yet as this animal matter is but little known among physicians, I shall briefly describe its principal characters.

Calculi formed of this substance; are semi-transparent, and of a yellowish colour; they have a lustre similar to that of bodies of a density powerfully refractive.

When cystic oxide is distilled in a retort, it furnishes carbonate of ammonia, of a fetid odour; there also passes a heavy fetid oil, similar to that obtained from animal matter, but in a much less considerable proportion than that which results from the distillation of uric acid.

These properties of cystic oxide show us, that, like uric acid, it is principally composed of azote; it is then very probable, that it is produced by causes analogous to those which determine the formation of uric acid. This substance is but very slightly soluble in water, and not at all in alcohol and the acetic, tar-



taric, and citric acids; it is, on the contrary, soluble in muriatic, nitric, sulphuric, phosphoric, and oxalic acids, as well as in potash, soda, lime-water, and the carbonates of potash and soda. The greater number of these properties resemble those of uric acid. It has not, however, been rigorously analysed. Cystic oxide was discovered by Dr. Wollaston; it must not be confounded with a new species of urinary calculus recently described by Dr. Marcet, and called by him, from its yellow colour, xanthic oxide.

## CHAP. III.

## ON THE CAUSES OF GRAVEL.

FROM what has already been stated, it is evident that uric acid, which almost constantly forms the calculous concretions in the urine of persons affected with gravel, is not an accidental nor diseased production of the animal economy; but that this acid is one of the essential elements of the urine of a person in perfect health; we have only to observe, that in the healthy state it is wholly dissolved in the urine; and in gravel a portion of it is deposited in the cavities destined to collect and evacuate the fluid secreted by the kidneys.

To understand the direct causes of gravel, we must investigate those circumstances which produce the separation of uric acid from the urine, in which it should remain dissolved.



We have seen that uric acid is but very slightly soluble, since it requires about 1100 parts of boiling water, and 1800 parts of water at  $70^{\circ}$ , to dissolve one part of it by weight; the urine of man, in a state of health, being about  $98^{\circ}$ , can only dissolve about the  $\frac{1}{1500}$ th of its weight, supposing, what nothing appears to controvert, that the other elements of the urine do not tend to favour its solution. This being determined, it appears that there are three evident causes which may diminish, in a manner absolute or relative, the dissolving property of the urine as regards the uric acid.

1°. An increase of the quantity of uric acid, the quantity of urine continuing the same, or not being augmented in a relative proportion to the acid.

2°. A diminution of the urine, that of the uric acid remaining the same, or not diminishing in proportion to the quantity of urine.

3°. A diminution of the temperature of the urine, the quantity and nature of it remaining the same as natural, or

undergoing the modifications above described.

I am far from thinking that these three causes, separately or united, are the only ones which may produce gravel; but they must be considered the principal ones, according to the present state of our knowledge.

The greater number of those of which we shall hereafter treat, are either merely illusory, or ought to be regarded as accessory to those above-mentioned.



## CHAP. IV.

ON THE CIRCUMSTANCES WHICH AUGMENT THE  
PROPORTION OF URIC ACID, AND WHICH TEND  
TO PRODUCE GRAVEL.

IN the first rank of causes which increase the proportion of uric acid in the urine, and which consequently often produce gravel are, very nutritious diet, an habitual use of sumptuous tables with highly flavoured dishes, particularly those prepared with animal substances; in a word, the diet of the rich and the amateurs of good living. This observation is deduced from an extensive series of facts. Of the very considerable number of patients by whom I have been consulted respecting this disease, the greater part were persons who mingled much with society, of a full habit of body, and had passed the age of muscular energy; and who ate principally of meat, fish, and game;

all substances containing azote, and consequently furnishing matter for the formation of uric acid. One patient, wishing to escape from the consequences induced by such a regimen, had confined himself entirely to the use of eggs and milk ; but these substances containing azote, as well as other nutritive animal substances, must necessarily be productive of the same inconvenience.

Among the cases that I might adduce, the following appears to me to be well calculated to show the connection of gravel, or, what is the same thing, an excess of uric acid, with the mode of life and the kind of diet.

M. —, a merchant, residing in one of the Hanseatic towns, was possessed, in the year 1814, of considerable property, and lived in the style of a man of consequence ; he kept an excellent table, in the pleasures of which he indulged without restraint : he was at this time severely afflicted with gravel. An unexpected political event occasioned the loss of his whole fortune, and obliged



him to seek refuge in England, where he passed more than a year in a state of almost absolute poverty, from which he suffered the most extreme privations ; his disorder completely disappeared during this period. His affairs afterwards became re-established, he resumed his former mode of life, and he again became tormented by his old disease. A second reverse of fortune again deprived him of his property ; he went to France almost without resources, his mode of life was conformable to his pecuniary means ; — the gravel again disappeared. At length industry again placed him in easy circumstances ; he followed his inclination for the pleasures of the table, and it was then he consulted me, in consequence of the return of his complaint.\*

This person might have been intentionally subjected to various kinds of regimen, to ascertain their influence on the production of gravel, without our

\* He was at the same time affected with gout, which constantly appeared and disappeared with the gravel.

having been able to ascertain more evident and conclusive results.

Further proof of the influence of aliments on the production of uric acid, may be obtained from observations made on persons, who, habitually abstemious, make an usually hearty repast. The following morning, and sometimes the same evening, the urine becomes high coloured, and deposits a large quantity of uric acid.

If, with a full diet, a person leads a sedentary life, or uses but little exertion of the muscular system, — which is the case with men of letters, statesmen, persons of advanced age, and those of the higher ranks in general, — the chances in favour of the production of gravel are very numerous. The muscular system is that of which the nutrition is the most rapid, and which most abundantly consumes nutritive substances, when it is often put in action. Thus all persons who are to use great exertions of the muscles, previously eat freely of aliments containing azote. If the same kind of food be taken in considerable quantity



without much action of the muscular organs, azote becomes abundant in the system, from those organs not appropriating to themselves the nutritive matter, and is directed to the kidneys, the principal emunctory of azote; it is there transformed into uric acid, and tends to the production of gravel.

As long as the quantity of urine is sufficient to dissolve the uric acid that may be formed, the increase in the proportion of this substance is not productive of inconvenience, and this, without doubt, is what takes place in persons who use the kind of diet just described, and are not affected with gravel; but if the proportion of the urine does not increase in a ratio with that of the acid, or if it become less, the appearance of gravel must be expected.

Let us now investigate the circumstances which may increase or diminish the quantity of urine.

## CHAP. V.

ON THE CIRCUMSTANCES WHICH INCREASE OR  
DIMINISH THE QUANTITY OF THE URINE, AND  
WHICH ARE FAVOURABLE OR UNFAVOURABLE  
TO THE PRODUCTION OF GRAVEL.

ON considering the effects of fluids drank, distinctively from their chemical properties, we may with propriety assert that the urine will be relatively increased or diminished according as a greater or lesser quantity is taken ; of this we have constant proofs. But this proposition is no longer correct if the chemical composition of liquids be attended to. It is true with respect to beer, cyder, and all those composed principally of water ; but it is not so with wines which contain a great proportion of alcohol, and still less so as relates to spirituous liquors, which contain still more alcohol and less water. This proposition is not even exactly applicable to hot drinks,



such as tea, coffee, punch, &c. all of which tend more or less to increase cutaneous perspiration.

If then a person who takes a large portion of animal food, drinks a considerable quantity of watery liquids, the urine will be more than sufficient to dissolve the uric acid formed in the kidneys, and he will be less subject to be affected with gravel. But if, on the contrary, he drink but little, or not in proportion to the quantity of food he takes; or if the drink principally consists of fluids charged with alcohol, his urine will be small in quantity, and consequently will retain but a small portion of uric acid in solution; there will then be a disposition to the separation of it, and thence the formation of gravel.

If to drink copiously were sufficient to avoid gravel, the persons most exposed to it, that is, great eaters, would rarely suffer from it, for they in general have no scruples in this respect. But there is one particular cause hitherto little understood, which tends to produce an

opposite effect ; which is the diminished action of the kidneys from the use of animal food.

In the experiments I have made on animals, to ascertain the effects of aliments which contain, and those which do not contain, azote ; I discovered that the use of the latter sensibly increased the quantity of urine ; a dog, for example, fed with sugar and drinking a given quantity of water in twenty-four hours, passes a much greater quantity of urine than another dog drinking the same quantity of water, and fed on animal food. I have frequently made the same observation on man. Persons who live on animal food alone, for the purpose of curing some disorder, pass but a very small quantity of urine. It is just the contrary with those who use a vegetable diet. M. Clouet, wishing to ascertain, exactly, the nutritive property of potatoes, took this root alone as food for some length of time ; after twelve or fifteen days, a copious flow of urine came on, somewhat analogous to diabetes. We



have another proof of what I have advanced, in comparing the quantity of urine of carnivorous, with that of herbivorous, animals; every person knows that it is very considerable in the latter, while it is very small in the former. I shall make some further observations on this subject when I consider the treatment of gravel; at present I confine myself to the establishment of the fact, that the use of animal food, and other analogous aliments, tends to diminish the quantity of urine, at the same time that it increases the proportion of uric acid.

It is almost unnecessary to add, that all the causes known to diminish the quantity of the urine, such as an abundant cutaneous perspiration, sweats, accidental fluid evacuations, &c. will be favourable to the formation of gravel, by furnishing obstacles to the solution of the uric acid.

The same may be observed with respect to the habit of lying long in bed, which, by increasing cutaneous perspir-

ation, and rendering the passage of the urine from the kidneys to the bladder more slow, favours the formation of gravel. Van Swieten saw a man, who previously never had any symptoms of gravel, suffer severely from the passage of calculous concretions through the ureter a few weeks after recovering from a fractured thigh, for which he had lain in bed ten weeks, without change of position. After experiencing great pain, he passed a small calculus of an irregular form, and was subsequently affected with gravel. Similar effects may ensue from a habit of long retention of the urine in the bladder, if the urine be otherwise disposed to deposit uric acid.



## CHAP. VI.

ON THE INFLUENCE OF THE TEMPERATURE OF  
THE URINE ON THE DEVELOPEMENT OF GRA-  
VEL.

WE have noticed the principal circumstances which give rise to gravel, at all periods of life; there is one more, which is peculiar to old persons, — the diminution of animal heat which accompanies advanced age. I am assured of this fact from thermometrical experiments; that when a person has passed the sixtieth year, the heat of the body has in general decreased several degrees; it is rarely, for instance, that it is found to exceed 100°, even in the groin and arm-pits, which are the warmest parts of the surface of the body, and which almost always correspond with the temperature of the internal cavities.

The urine, which has only a borrowed heat from the blood and the surround-

ing organs, is necessarily of a lower temperature in old persons than in those in the vigour of life. In the experiments which I have made on this subject, I have rarely found it above 100°, which is several degrees below the ordinary temperature; supposing, then, all other circumstances to remain the same, it is evident from the diminution of the heat of the urine merely, that as a person becomes more advanced in age, after a certain period, they become more subject to gravel, since the urine is less adapted to the solution of the uric acid.

Perhaps the effect of great and long continued cold, by lowering the natural temperature of the body, and consequently that of the urine, may concur with other circumstances, in some cases, to produce gravel.



## CHAP. VII.

## ON SOME PARTICULAR CAUSES OF GRAVEL.

I HAVE mentioned the circumstances which, according to the present state of our physiological and chemical knowledge, we may conceive explain the reasons why the uric acid formed in the kidneys, does not remain in solution in the urine, but is precipitated in the form of sand or calculi. We must not, however, suppose that this theory is entirely satisfactory ; for we every day see individuals who, from their age, diet, and habits, seem to have every condition tending to produce gravel, and yet are free from it ; there exists then some unknown causes which facilitate the solution of uric acid in the urine, even when it exists in a considerable proportion.

We on the contrary see persons, who, from their diet and mode of life in gene-

ral, would appear not to be liable to gravel, and yet suffer from it. These instances are indeed rare, but the fact is not the less certain; such are the poor inhabitants of a district between Tunbridge Wells and Lewes, in Sussex; gravel is very common among them, although they are of spare habits, and live almost entirely on vegetable food, and hard beer. Dr. Scudamore, who relates this fact\*, observes, that the higher class of the inhabitants are free from the disease. It is much to be desired, that the author had stated whether or not the calculous matter evacuated was formed of uric acid.

There are some persons, who, whenever they take violent exercise to which they are unaccustomed, pass a considerable quantity of gravel with the urine. It is not very uncommon to see the same phenomenon occur in persons of abstemious habits, and who are otherwise in good health, when they suffer from dif-

\* In his treatise "On the Nature and Cure of Gout and Rheumatism." London, 1818.



ficult digestion accompanied with pyrosis, &c. I know a female who voids about two drachms of red gravel with her urine, the day after having eaten of salad. M. Beclard has furnished me with an account of a person who expels one or two small calculi from the urethra, every time he eats fruit that has not undergone culinary preparation.

These, and other analogous facts, have not escaped the observations of many eminent authors, and particularly some of the English physicians; but they have endeavoured in vain, as far as I can judge, to give a satisfactory explanation of them. Is our knowledge much advanced in this respect by the assertion, that in those cases, *the stomach is in a morbid state*; or that *the primæ viæ are surcharged with acid*; or that *the liver does not properly perform its functions*? We are the more astonished to meet with such language in several works lately published in England, since we observe, with much pleasure, that the study of medicine is there conducted in the same

mode of experimental inquiry, which is now followed in the greater number of the other branches of natural philosophy.

I do not consider the dyspepsia, and many other chronic diseases, that frequently accompany gravel, as the cause of it; for every thing leads us to suppose that dyspepsia and gravel which exist simultaneously in the same person, are two effects of the same cause, and that they do not reciprocally produce each other.

Has climate any influence on the production of calculous affections in general; and on that of gravel in particular? Authors affirm that it has. It has indeed been long observed, that the inhabitants of moist and temperate climates were more subject to stone, than those of cold countries and of the equatorial regions; it is very rare, for instance, to find a person affected with gravel in India; all the physicians who have had opportunities for observation, agree on this point. But in deciding this question in the affirma-

tive, have they separated as they ought to have done, what depended actually on the climate, from what should be attributed to diet? Is it not possible that the absence of calculous disorders in hot climates depends in some measure on the vegetable diet, which it is known is particularly used in those countries. I should be led to believe so from the following fact, which was related to me by M. Orfila.

The inhabitants of the island of Majorca feed principally on fish and other animal substances; which are highly seasoned with pepper and other spices; their drink is a generous wine, the strength of which they but rarely diminish with water; they also drink a considerable quantity of brandy, rum, punch, &c. M. Orfila, during the time he remained in that island in the year 1816, remarked that calculous disorders were very common there, and that the urine of the inhabitants was in general charged with a great quantity of uric acid, which was voided in the form of calculi after



having caused acute pains in the loins and course of the ureters.

How many errors have been, and still are, spread abroad respecting the causes of gravel. It has long been believed, for instance, that the stony concretions of some species of fruits, waters containing selenite, &c. frequently produced this disease. These ideas, often favoured by the most respectable authors, were founded on a pretended similitude of nature between calcareous salts, and the elements which compose stone and gravel: but the discoveries of modern chemists have dispelled this illusion, by demonstrating that the matter composing urinary calculi, has for the most part no analogy with the salts formed of a basis of lime, and still less with the concretions of various fruits. Indeed the lapidiform concretions found in these substances, particularly in pears, which have been considered as composed of calcareous earth, do not merit this denomination. When observed by the microscope, they do not appear to be formed of concentric layers,

but by an assemblage of hard particles, united by filaments of various degrees of fineness. M. M. Maquart and Vauquelin have examined them chemically, and found them to be composed neither of carbonate nor phosphate of lime, nor of uric acid, as was suspected, but of a woody substance, similar to that of the tree which produces the fruit, crystallized in a confused manner, and mixed with a particular species of farina. Thus, those pretended stones in fruit are not in any way capable of producing urinary calculi. I have also been able to ascertain, several times, that they passed through the intestinal canal without alteration.

Waters charged with carbonate of lime, are not more calculated to produce gravel than the concretions I have just described. Hales was, however, persuaded, that these waters suffered their earthy particles to be deposited in the excretory vessels of the kidneys, in the same way as they are on the sides of canals through which they pass; but this

doctrine, instead of being confirmed by observation, is found to be just the contrary to what is really the fact, for those waters are often usefully employed in the cure of gravel. According to the experience of Choppart and Desault, who practised surgery in the largest hospitals in Paris, it is very rarely that a person affected with stone or gravel can be found in the village of Arcueil, although the water there is charged with carbonate of lime. When we also consider, that the elements of urinary calculi have no analogy with those of that salt, it is impossible to avoid rejecting the opinion of Hales.

What has been said respecting calcareous salts, is in a great measure applicable to culinary salt, considered by many authors as being calculated to produce gravel; the difference of nature that exists between this substance and urinary calculous concretions, is sufficient to abolish the idea that its use, or even its abuse, can produce any thing similar to gravel.



The different questions relative to the prejudices of men of science and the people in general, respecting the causes of calculous disorders, have been examined with much care and attention by Dr. Henry, in his excellent Dissertation on Uric Acid.

On taking a general view of this subject, we perceive that all the causes of gravel, direct and indirect, may be reduced to the following :

1. Mature and advanced age.
2. Too nutritious diet, principally composed of substances containing a large proportion of azote.
3. The want of sufficient exercise, literary labours, lying too much in bed, &c.
4. A habit of drinking but little of liquids of any kind.
5. The use of generous wines and spirituous liquors.
6. Copious perspiration, and all serous evacuations occurring in persons otherwise disposed to gravel.

7. The ill habit of long retention of the urine in the bladder.

8. Particular causes, the effects of which cannot be mistaken, although their mode of action cannot be explained.

All that has here been said respecting the causes of gravel, should only be applied to that which is formed of uric acid. The particular causes of gravel formed of phosphate of lime, oxalate of lime, cystic oxide, &c. are entirely unknown; fortunately, instances of this kind are very rare, and we may say exceptions to the general rule, which teaches us, that the deposit from the urine of persons affected with gravel, is formed of uric acid.

## CHAP. VIII.

REMARKS ON THE SYMPTOMS OF GRAVEL, AND  
ON THE SITUATIONS IN WHICH THE CALCULOUS  
CONCRETIONS ARE FORMED.

WE may observe in the greater number of instances, that patients for some months previously to the appearance of gravel, experience a sense of irritation and fulness in the region of the kidneys, the urine is of a deeper colour than natural, and deposits an hour or two after it is voided, a reddish coloured sediment, more or less abundant in quantity. But little attention is usually paid to the early symptoms; after a time, they increase in severity, the sense of fulness in the loins is changed into a painful weakness, varying in degree. On the day following that on which it has been most severe, a portion of sand is evacuated with the urine. The expulsion of it often takes



place without pain, but it is also sometimes accompanied with a sense of heat, and even of burning, along the urinary canal. In some more rare cases, it excites very acute pain in the bladder and urethra, accompanied with anxiety, fever, restlessness, &c.; symptoms which continue unrelieved, until after the expulsion of the red sandy particles.

As long as the evacuation of which we are speaking only takes place at distant periods, once or twice a year, for instance, a person cannot be said to be actually affected with gravel, he has merely a disposition to it. When it occurs more frequently, if, for example, it returns several times in the course of a month, whether or not it be attended with pain, the disease termed gravel properly exists. The disorder rarely remains long in this state; the pains in the kidneys soon increase, and are at times almost insupportable; the patient is often sensible of the descent of a foreign body through one or both of the ureters, the passage of which is marked by a sort of tearing

sensation of the canal through which it passes. These symptoms are almost always accompanied with frequent desire to void the urine, retraction of the testicles, cramp in the lower extremities, nausea, and vomiting. The patient cannot remain long together in one posture; he is unable to stand upright, much less to walk; sometimes even he cannot bear the motion of the most easy carriage. These symptoms generally continue from thirty-six to forty-eight hours, and then suddenly cease. At length, after a longer or shorter period, most frequently during the same day, the patient perceives that there is a solid body in the urethra, which is pushed forward by the urine, the evacuation of which it partially obstructs, until the paroxysm terminates in its total expulsion. This solid body is a calculus, the painful course of which through the urinary passage, has been more slow and difficult in proportion to its bulk, its irregular form, and the narrowness of the canal through which it passed.

The passing of calculi through the

urethra of women is attended with less difficulty, in consequence of the shortness of the space, and the extensibility of the canal; but their course through the ureter is neither more rapid nor less painful than in men.

Calculi voided from the urethra in this way, are rarely solitary, there is almost always a succession of them of various sizes.

My intention has not been, to describe the particular symptoms of gravel, because they are generally well known; but I have said sufficient respecting them, to furnish the following deduction, which is of great importance in the treatment of the disease; that the solidification of the uric acid takes place as soon as the urine is formed, that is to say, in the pelves, and, perhaps, as the sensation of irritation, giving an idea of the creeping of ants, and the dull pain the patients experience seem to indicate, in the tubuli of the kidneys; where patients readily perceive the existence and formation of the urine before it arrives at the ureter.



If it were good reasoning to deduce a general from a particular conclusion, we might consider this fact as demonstrated; for Choppart \* affirms, that he has seen small portions of gravel in the papillary and tubular substance of the kidneys. Many other authors have made the same observation.

Nothing however opposes the opinion, that this solidification may take place either in the ureter, or in the bladder; for it may happen that there may be certain causes proper for its production in these parts which do not exist in the kidneys.

When gravel has once formed in the pelves of the kidneys or elsewhere, it continues to increase by receiving on its surface new layers of uric acid successively precipitated, which we may be convinced of by cutting the concretions transversely; when we perceive that they are almost entirely composed of concentric layers.

\* *Maladies des Voies Urinaires.*

Proportionate to the slowness and difficulty of their descent, is the reason to fear that their size may increase; and, reciprocally, the greater their bulk, the more we must suspect that their passage will be slow, and consequently that their dimensions may become still more considerable.

The red sand, from the facility with which it in general passes through the whole course of the urinary passages, does not furnish cause for so much alarm; but if the quantity of urine be small, the sand itself descends towards the urethra with a certain degree of slowness; the particles increase in bulk and become small stones, which may develop themselves in the manner above described.

If in consequence of its size, the irregularity of its figure, or a particular disposition of the urinary passages, a calculus becomes arrested in any part whatever of the urinary canal, it will then increase and form an obstacle to the progress of other calculi; it is in this way that

stones of the kidneys, and the greater number of those of the bladder commence, which, from chemical analysis, are found to be frequently composed, either wholly or in part, of uric acid.

Stones in the pelves of the kidneys, the ureter, and the bladder, are then, for the most part, merely the consequences of gravel, or, in other terms, the third degree of that disease, of which the voiding of sand is the first, and the expulsion of calculi the second.

If physicians shall one day determine, not to see in diseases any thing more than a modification of the phenomena of health, instead of abstracted and imaginary existences, it will, without doubt, be necessary, both for the study of the symptoms and the treatment of the disease in question, to connect together all the different consequences of the solidification of uric acid in the urinary passages.



## CHAP. IX.

ON THE CURATIVE INDICATIONS AND GENERAL  
MEANS FOR THE TREATMENT OF GRAVEL.

FROM the foregoing detail of the causes and symptoms of gravel, it is easy to establish the principal indications for the mode of treatment of that disease :

*To diminish the Quantity of Uric Acid formed in the Kidneys.*

*To increase the Secretion of Urine.*

*To prevent the Solidification of the Uric Acid, by saturating it.*

*In the Case of Calculi being formed, to favour the Expulsion of them from the Bladder, and to attempt their Solution.*

## § I. ON THE CURATIVE INDICATIONS.

*To diminish the Quantity of Uric Acid formed in the Kidneys.*

THE existence of uric acid being connected with the use of animal or vegetable

substances as food, which contain azote, and the proportion of that acid being almost always in a direct ratio to the quantity of the aliment employed ; nothing more in general is required to effect the object of the first indication, than a restriction of diet as regards the use of those substances. But in certain cases, which are by no means rare, it will be necessary to dispense with them entirely, and substitute for them those matters which contain but little or no azote, and which consequently are not calculated to induce the formation of uric acid.

It is principally when the urine contains red sand, that the first mode is efficacious ; I have often seen persons cured in this stage of the disease, merely by ceasing to take animal food at breakfast, to which they had been accustomed. Eight or ten days after this change in diet, they perceived the red sand begin to diminish ; and it has rarely happened that it has not disappeared after three weeks or a month, provided they

do not eat at dinner so as to make amends for the privation which they have suffered at breakfast.

When persons accustomed to the use of animal food at breakfast adopt this regimen, they sometimes experience a slight degree of weakness from the change; but this should not alarm them, as it disappears in a few days, and is often succeeded by a sensation of lightness and activity of body and mind, which they did not previously possess.

This method is only applicable to persons accustomed to the mode of diet to which we have alluded; other means must be taken with those who have been in the habit of taking animal food only once in the day. We must then enforce a degree of abstinence, making them lessen their usual quantity of food, in the proportion of one quarter or one half. This simple measure, which soon produces a cessation of the formation of sand, is often effected with much difficulty. Dinner is, with many persons, particularly those of an advanced age, the most



important action of the day; it is the source of true and positive enjoyment; the advice which inculcates the necessity of restraint in this respect, is not unfrequently very ill received; or even, if after having been informed of the serious consequences which will result from his disorder, the patient in the morning forms a resolution to submit to your directions, it is very different with him when the advice is to be put in practice; appetite and food are present, pleasure is to be experienced, distress and danger are far off, the Doctor has exaggerated the matter; — how can he resist? I have several times met with persons who, although persuaded of the dangers into which they were running, could not impose so much restraint on themselves as to diminish, even by a single ounce, their usual quantity of food, and who, without exaggeration, took five times as much as was necessary for their support.

We do not experience so much difficulty where calculi exist; the pain and

other accidents which accompany their course through the urinary passages, speaks every instant in favour of the restricted regimen, and often reminds the patient when at table of the necessity of moderation.

Unfortunately this diminution of the quantity of food, which is sufficient to cause the disappearance of sand in the urine, is not so effectual for the removal of calculi — although the number and bulk of them may not be considerable. We must then have recourse to more powerful measures, of which I shall presently treat.

I have, however, seen many persons in this state considerably benefited by simple change of diet. — Such was the case with a Belgian clergyman, who, having suffered from gravel to such a degree that he could not walk, nor even ride in a carriage, followed my advice, and considerably diminished the quantity of his food. After a month he walked with ease, could ride in his carriage without the least inconvenience, and

soon afterwards began to take short journeys on horse-back.

A lady of Paris, from sixty to sixty-five years of age, who had been subject to gravel for several years, read in a journal an incorrect statement, in which the discovery of a mode of curing stone and gravel by the use of sugar, was attributed to me ; without any other information this lady began to eat sugar in considerable quantities, frequently more than a pound daily ; the use of this substance obliged her to diminish considerably the quantity of her other food, and indeed almost to relinquish it altogether. — She continued to use these means about six weeks, when the gravel was entirely removed. The use of the sugar was then relinquished, from its disagreeing with the stomach, and she adopted her former diet ; after three months the calculous concretions re-appeared.

I was consulted towards the latter end of last year by an old gentleman, who appeared to have experienced the same effects, after having followed the same



conduct. In this instance, the use of sugar had produced great debility of the stomach, and a disordered state of the digestive functions.

But it will be inquired by those who are to be subjected to the regimen I have described, are there not amongst the different species of food, some which may replace those of which I am to be deprived, and which are not productive of the same inconveniences?

Without doubt, bread, particularly that made with rye-flour, pastry, the farinaceous legumens, Italian paste, rice, potatoes, the green legumens, sugar, &c. may be advantageously employed as food, particularly when simply prepared; with these the patient may without danger satisfy his appetite. He must not, however, indulge in the use of these substances without regulation, as some of them, such as wheaten-bread and pastry, contain a considerable proportion of azote.

When patients adopt this regimen, they must avoid spirituous liquors, and wine in an undiluted state, and they

ought to drink copiously of aqueous fluids: such liquids rendering the urine more abundant without increasing the quantity of uric acid, will necessarily diminish the proportion of the latter to the former.

Notwithstanding all these precautions, gravel will too often continue to exist, and if it be accompanied with much pain, or the calculi are considerable in size and number, it is evident that mere diminution of the quantity of azoted aliments will not be sufficient; they must be relinquished entirely, until the gravel disappears, or is in some degree diminished; these are the means to be adopted, if the mode of treatment of which I shall hereafter treat be not preferred.

There are few persons who have the resolution to conform to this mode of life, and thus to overcome habits oftentimes contracted during infancy; I have, however, seen many who have followed it rigorously for upwards of six weeks; it is true, the pain they had suffered from

gravel, had rendered them so patient, that they would have made any sacrifice to be relieved from it.

To convey an idea of what may be effected in this way by the consequences of gravel, I shall transcribe a passage from the letter of a provincial magistrate, a great lover of the pleasures of the table. He had suffered extremely from that disorder, when I first advised the regimen above described to be carried to the most rigorous extent.

“ Immediately after rising in the morning, I take a cup of weak tea, and during the forenoon some orgeat made with cold water.\* I dine at noon on legumenous vegetables and fruit, drinking several glasses of water, to which is added a little old white Bourdeaux wine ;

\* At that time M. M. Vogel and Boullay had not published the results of their examination of the composition of almonds : I did not then know that orgeat was an azoted substance, I advised it as not containing that principle. Another proof of the utility of chemical knowledge in the practice of medicine.



and with the dessert, I take two or three small glasses of the same wine undiluted. Towards five o'clock in the afternoon, I drink rather freely of water containing a little sugar. In the evening I eat some rice or gruel made thin, with both of which I take a little butter; I drink wine and water again with this repast, and when going to bed, I take a glass or two of sugar and water. The use of rye-bread is the only part of the regimen that I feel much dislike for; this certainly is very disagreeable to me, as I have always been a greater eater of white fermented bread, besides which, from the rye having been this year (1816) got in in a wet state, the quality of the bread suffers considerably from it.

“ This regimen is without doubt,” adds the same patient, “ extremely severe, but if I am so fortunate as to be relieved by it from my disease, and the serious consequences which arise from it, it will be a good bargain; for although a good kitchen may be a great comfort,

health is a thousand times preferable to it."

The hopes of this patient were not disappointed; after having continued this regimen for six weeks, the sand and gravel had disappeared, and I suppose that he has not experienced a relapse of the disorder, from his not having written to me since that time.

A fact which I must not omit to mention, is, that in the above instance, the patient, after about twelve or fifteen days from the time he commenced this mode of treatment, made a very large quantity of urine, quite disproportionate to the quantity of fluids which he drank; a circumstance which, without doubt, contributed in no small degree to the relief of his disease. I have seen a similar consequence take place in the experiments I made to ascertain the effects of food not containing azote, on man and animals. This leads us to the consideration of the second curative measure for the disease of which I now treat.

## § II. ON THE CURATIVE INDICATIONS.

### *To increase the Secretion of Urine.*

THE most simple way to increase the secretion of the urine, and that which naturally presents itself, is to drink copiously, particularly of aqueous fluids which are known to be diuretic. This measure is indeed the resource of the greater number of patients affected with the disease, who, to diminish the quantity of gravel, and to favour its expulsion, drink abundantly, and urine in proportion. Many, merely by this practice, without change of diet, experience so much advantage, that calculi are very rarely evacuated, and some are so fortunate as to be relieved from them entirely.

To produce these effects, it is of but little importance what the drink may be, provided that water forms the principal part of it. Thence a great number of decoctions, infusions of vegetables, mineral waters, &c. have been celebrated for



the cure of this disease; such are the decoctions of cherry-stalks, dried figs, parietaria, sassafras, pariera brava, and linseed; such also are table-beer, the waters of Spa, Contrexeville, Luxeuil, Bussang, &c. All these fluids, to which a small quantity of nitre is sometimes added, excite the action of the kidneys and render the urine abundant. It is probable, that the natural and artificial waters charged with carbonic acid act in the same way.

These different fluids may not be indiscriminately employed in all cases, for such as agree with the stomach of certain patients, will produce a decided diuretic effect, while in those with whom they disagree, they will remain undigested, and have no diuretic effect whatever. We must then make a choice, and give the preference to such as may be agreeable to the taste, do not oppress the stomach, and produce the most marked diuretic effect, without otherwise regarding the nature of the liquid.

When the liquid which possesses these

qualities is discovered, the patient should take it in considerable quantity. Ten or twelve pints daily will not be too much, particularly if the disorder be very severe. The quantity may be less in cases in which the gravel only shews itself, after long intervals.

The inconvenience most to be feared from this treatment, is the production of debility of the stomach and abdominal viscera, the appetite falls off, digestion becomes laborious, and a general weakness affects the patient; these circumstances render a moderation of the quantity of liquids necessary, and oblige us to choose such as possess aromatic properties.

I have several times checked the disorder thus produced, by giving iced drinks.

Such is the quantity of uric acid formed in the greater number of cases of gravel, and such is the want of solubility of this substance, that however abundant may be the urine, it is not sufficient to hold

the uric acid in solution, and consequently to prevent the formation of gravel.

This unpleasant result will be more experienced in proportion as the food is more nutritive, and as the uric acid may be in greater proportion. We have formerly said, that an azoted diet has also the effect of diminishing the relative proportion of the urine, and it has been shown that a vegetable or non-azoted diet, has exactly the opposite effect; that is, it relatively increases the quantity of urine independently of the quantity of drink.

I may repeat here what I said when treating of the causes of gravel, that generous wines, strong liquors of all sorts, coffee, tea, punch, &c. excite the action of the kidneys in a much less degree than aqueous drinks and very light wines; we must take into account this property of spirituous fluids in the advice we give to patients, we must not permit the use of them unless they will consent to take



them diluted with a large proportion of water, and thus render them more adapted to excite the action of the kidneys.

To fulfil the second indication in the cure of gravel, it is sufficient to drink copiously of aqueous fluids, to be sparing in the use of generous wines and spirituous liquors, to lessen the quantity of animal food, and to substitute for it, as far as possible, substances which do not contain azote.

When the regimen described in the foregoing paragraph, is not effectual in preventing the solidification of uric acid in the urinary passages, we must have recourse to a method, for the knowledge of which we are indebted to chemistry and physiology, which consists in making the acid combine with alkaline or earthy bases, so as to form salts more soluble than the acid in a separate state. This forms the third curative indication.

## § III. ON THE CURATIVE INDICATIONS.

*To saturate the Uric Acid.*

IT is well known, that certain alimentary and medicinal substances taken into the stomach, very quickly impart to the urine particular qualities, some of which change its odour, as asparagus; others its colour, as rhubarb; many saline substances pass unaltered into the urine with equal rapidity. Darwin having persuaded one of his friends to take a few grains of nitrate of potash, examined his urine half an hour afterwards, and found the salt in it: I have often ascertained the same fact in men and brute animals with other salts, as well as the nitrate of potash, such as the prussiate of potash, which is a substance well adapted for this experiment, since it is very easy to discover the smallest quantity of it in the urine.\*

\* The rapidity with which simple liquids and medicines pass from the stomach to the urinary bladder, has at all times excited attention as a wonderful

But the nitrate, sulphate, and prussiate of potash, although they quickly pass into the urinary organs after having been received into the stomach, are not adapted to saturate the uric acid. The affinity of the bases of these salts with their acids, is too great to permit any decomposition to take place when they come in contact with that substance. This is not the case with the alkaline carbonates where the bases are in excess, and which thus offer the conditions necessary for their combination with uric acid. When these salts meet with this

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occurrence, and many hypotheses have been formed to account for it. Many physiologists of the present day consider it inexplicable. How can these liquids pass so rapidly through the chyloferous vessels, the mesenteric glands, the whole of the thoracic duct, and afterwards traverse the course of the circulation? This objection certainly cannot be replied to; but may not these liquids take another course? They are taken up by the veins of the intestines, and immediately carried into the organs of the circulation, as I have demonstrated by a series of experiments. See my *System of Physiology*, vol. ii.



acid in the urine, a chemical decomposition takes place, the uric acid combines with the excess of their bases, and forms urates with great facility, from but a small quantity of the base being required for its saturation.

Although the uric acid may be saturated, all fear of the formation of sand or calculi is not obviated, for the urates are only soluble when the bases are in excess, and they are decomposed by the weakest acids; it will be necessary to preserve an excess of alkali in the urine, to prevent the urates being precipitated, and forming a new species of gravel, which would be productive of not less inconvenience than the ordinary kind.

To produce this second effect, it is not only necessary to make the alkaline carbonates pass into the urine, but also to preserve them in it in sufficient quantity, that all the acids formed in the urine may be saturated, and a proportion yet remain undecomposed. We may readily know when this effect is

produced, by the urine possessing alkaline qualities.

This important result is easily and promptly produced in carnivorous brute animals, whose urine, similar to that of man, is acid. I have several times seen that of dogs become sensibly alkaline in two hours after they had swallowed a certain quantity of the carbonates of lime, soda, or potash; it is not difficult to produce the same phenomena in man.

Since the carbonates produce this effect, the pure alkalies, from more evident reasons, will possess the same advantages; indeed experience has long shown, that pure potash and soda, properly diluted with water, combine with the uric acid as soon as they enter the urinary organs: similar effects are obtained from lime.

The correct theory of the influence of alkalies and the absorbent earths on the acids of the urine, and particularly uric acid, is due to modern chemistry; but the fact had long since been established.

In the beginning of the eighteenth century, an English woman, of the name of Stephens, born of reputable parents, in Berkshire, having been accustomed from the early part of her life to prepare medicines for the poor, found by chance, that the internal use of egg-shells, well calcined, and afterwards exposed for a long time to the air, was beneficial to persons affected with stone and gravel. — Her method at first consisted in giving three doses, of about two drachms of the powder of egg-shells thus prepared (these shells are composed of carbonate of lime): as this produced constipation of the bowels, she afterwards added half an ounce of soap dissolved in water; she supposed this substance to be also adapted for the solution of calculi: and lastly, to prevent the discovery of her secret, she mixed with the egg-shells and soap, the calcined shell of the razor-fish, some of the charcoal formed by burning stags' horns, and a proportion of fennel, bardane, &c. There were so many testi-



monies of cures effected by this remedy, that Mrs. Stephens petitioned parliament, in 1739, that she might obtain a recompence on making the remedy publicly known. A committee of twenty-two persons well qualified for the investigation of the subject, was formed; they made several trials of its properties, and then declared that they were convinced by experience of the utility, efficacy, and virtue of the remedy; Mrs. Stephens, in consequence of this, received the sum of 5,000*l.*: her method was made public, and every person had now himself the means of ascertaining its efficacy.

Among the physicians who investigated this subject, we must mention Moraud, of Paris. In two memoirs presented to the Academy of Sciences, one in 1740, and the second in the following year, he related a great number of cases, almost all of which were in favour of the remedy. The greater number of patients who used it, were either perfectly cured, or much relieved.

Many other men of science, as Hales,

Hartley, Whitt, &c. made experiments with this remedy, and supported, each according to his own notions, the good effects of alkalies and the absorbent earths in calculous affections of the urinary organs.

These ideas respecting the treatment of gravel, assumed a more consistent character after the renovation of chemistry, when, lime, the carbonate of potash, that of soda, &c. were used to combat this malady, and the most evident success was often obtained by these means.

At the same time that chemical knowledge contributed to support the good effects of alkaline and earthy substances in saturating the uric acid, it also appreciated the true value of several pretended lithontriptics that had previously been in repute: among these were the decoction of dried figs, the juice of onions, lemon juice, petroleum, bullocks' blood, millipedes, &c.; it showed that these substances could only be beneficial as diuretics.

One of the first cases treated by the

use of alkaline carbonates in large doses, was that of the celebrated Mascagni. The following is the manner in which he expresses himself on this subject in the "Memoirs of the Italian Society," for the year 1804.

"I had been for several years subject to pains about the loins, and from time to time voided gravelly particles of a yellow-ochre or brick colour. Knowing that the alkaline gaseous water was used in similar cases, I took it several times, and experienced relief from it. \* I imagined that I should obtain still better effects from carbonate of potash. In the month of October 1798, I exposed a solution of carbonate of potash to the action of the acid which is disengaged from grapes during fermentation; I thus obtained carbonate of potash well saturated.

"In the months of August and September 1799, having been *obliged to lead a sedentary life*, I became cruelly afflicted

\* The water of which Mascagni here speaks is the Seltzer water, *aqua alcalina mofetica*: it contains carbonate of soda.



with pains in the kidneys, and I passed a considerable quantity of gravel, some of the particles of which, from their weight, might be considered as true calculi ; they were red and crystallized, and were found in the vessel every time I voided my urine. They might be distinguished by their brilliant appearance through the urine, which was transparent. I was also subject to a superabundance of acid in the stomach, which was sometimes tasted in the mouth. I examined my urine, and recognized in it a free acid, which I discovered, as well as the gravel, to be uric acid.

“ Being thus assured of the nature of the concretions which I voided, I resolved to make use of the carbonate of potash, and to observe its effects. The first day I took a drachm, half in the morning fasting, the remainder in the evening. I dined at one o'clock. The salt, dissolved in ten ounces of water, had very little taste, it did not affect the stomach or intestines ; but as soon as I swallowed it, a disengagement of a

considerable quantity of carbonic acid gas took place.

“ The second day, I took two drachms; the third, three drachms \* ; this I continued for ten days, dissolving it in twenty ounces of water.

“ Before I used the carbonate my urine was very acid, and immediately reddened the turnsole paper. The second day after taking it, the urine produced but little change of colour of the paper, and none whatever on the third. The acid of the urine was then saturated. At this time the pains in the kidneys began to be diminished, and I voided no more gravel with the urine. At length the pains entirely ceased, the urine became less charged, and I discovered the potash in it in excess.

“ I then ceased to use the carbonate of potash, and for several months after voided no gravel. Having since been attacked with the same disorder, I had recourse to this remedy, and obtained

\* The Florence drachm is equivalent to about 64 English grains.

from it similar good effects. I have repeated this medico-chemical experiment every time that I have suffered the same inconvenience, and always with success. For these two years past I have not voided any gravel, although I have not taken the salt of potash."

This account of Mascagni is the more interesting, because all that bears any relation to the causes, symptoms, and treatment of the disorder, is expressed with so much clearness, and with such admirable precision. We must particularly remark the change that took place in the acid state of the urine, during the first few days in which the potash was used, and the disappearance of the symptoms as soon as the urine became alkaline.

The mode of administering the alkaline carbonates is very simple, but yet this point requires some elucidation. The carbonates of soda and of potash being soluble in water in any proportion, may be given in many different vehicles without distinction, in a more concen-



trated solution, and in the solid form: this is not the case with the carbonates of lime and magnesia, which are not soluble in water: we are obliged to administer these in a pulverulent form, or suspended in water by means of mucilage. Their insolubility renders them in general less efficacious than the preceding substances; sometimes they are not absorbed from the stomach, and form concretions in the intestinal canal which may cause serious accidents.

The doses in which the different carbonates may be given is not the same; those of lime and magnesia may be carried to the extent of several drachms in twenty-four hours; many persons have taken an ounce of them in that period. The use of the carbonates of soda and potash requires more circumspection; if the quantity be greater than from twenty-four to thirty-six grains daily, derangement of the functions of the stomach and vomiting frequently take place; and these circumstances not very rarely

occur, when the quantity has not been so great as that just indicated.

Still further precaution will be necessary where pure soda or potash is employed; these two alkalies, from their causticity, cannot be administered except they are diluted in such a proportion of water, that hardly any impression is made on the tongue by them. Patients may take to the extent of a pint of this solution daily, without any inconvenience.

Pure lime may be administered in the same manner; but the dose of its solution may be raised to two pints: the common lime-water is proper for this purpose.

Magnesia, the good effects of which were more particularly made known by Mr. Brande, may be used when the other medicines have failed; it may be taken under various forms, and in almost any doses; in powder suspended in water, in pastiles, or in boluses, from ten grains to an ounce and more, in twenty-four hours.

Although several mineral waters contain the alkaline and earthy carbonates, and may be usefully employed in the treatment of gravel, it is rarely that they can perfectly saturate the uric acid, because of the small quantity of the salts they contain. Their most evident effect is an increase of the secretion of urine.

It may perhaps be asked, which of the substances that I have mentioned is preferable, that is to say, produces the most prompt and evident good effects with the least inconvenience. It is difficult to reply to this question; advantageous results may be adduced in favour of each of them: but there is not one of them, the use of which has not, in some cases, been necessarily suspended; either from their producing purging, or disagreeing with the stomach, or because they excited pain in the urinary passages, particularly in the bladder and urethra. The art of employing them consists in continuing their use as long as they are efficacious, and in ceasing to do this as soon as any unpleasant effects appear; and, lastly, to



vary them with judgment according to circumstances ; for a person who cannot bear a few grains of carbonate of soda, will experience no inconvenience from potash, and the same with the other substances which I have described. But which-ever of them may be employed, its evident effect should be an alkaline state of the urine, without which nothing can be expected from them in the cure of gravel, at least no result which can be theoretically accounted for will be produced. If it produce any amelioration, it must then merely be considered as a simple empirical measure.

The alkaline property which the urine acquires from the use of the alkalies and absorbent earths, merits our attention in a physiological point of view. The whole surface of the intestinal canal being imbued with a powerful acid which is continually renewed, it is at first difficult to conceive how it is that the alkalies do not combine with this acid, and the carbonates become decomposed ; these combinations do indeed take place, as theory

indicates, but from the small quantity of acid contained in the stomach and intestines, and the promptness with which they are absorbed, the greatest part of the carbonates, or other alkaline substances, passes into the blood before it can be attacked by the acid of the digestive organs.

When they become mixed with the blood, decomposition of those salts, and saturation of their bases cannot happen, for the blood being itself alkaline does not possess any of the chemical qualities adapted to produce such a result.

It is not so easy to explain the passage of an acid from the stomach to the bladder, for as soon as it enters the veins and becomes mixed with the blood, it should necessarily combine with the excess of alkali of the serum; so the passage of acids from the intestinal canal into the bladder is still doubtful. The experiments on which authors rely to substantiate it, do not appear to be satisfactory. Because carbonic acid had been obtained from the urine of a person who had drank

water saturated with that acid, it does follow that the acid of the urine was that which had been taken into the stomach, for the urine naturally contains carbonic acid. I do not regard this transmission as impossible, but only desire to have more evident proofs of it, if it be a fact. I have several times tried to put a stop to the alkalinity of the urine, by giving mineral and vegetable acids in large doses, but I have never been able to obtain this result in an unequivocal manner.

The use of alkalies as a curative measure in gravel, is, however, one of those of which the effects are the most prompt and evident; the relief thus afforded in some cases is astonishing. I have seen the most violent paroxysm of nephritic pains from calculi alleviated in a few hours by these remedies; it is very rare that this effect is not produced in the course of a day or two. But it must also be observed, that if the regimen be not changed, and the general causes of gravel obviated by the means already pointed out, the use of these medicines can only



be considered as palliative, the effects of which will subside after a certain length of time.

#### § IV. ON THE CURATIVE INDICATIONS.

*To favour the Expulsion of Gravel and Calculi ; and attempt their Solution.*

THIS curative indication is not less important than the preceding ones, and in some instances it becomes even more so : it is indeed because the calculi are not easily expelled, that gravel is accompanied with serious accidents, such as pain, fever, vomiting, suppression of urine, hemorrhage, &c. ; and it is from those concretions being retained, either in the pelves of the kidneys, the ureters, or the bladder, that this disease may become destructive to life.

As soon then as pain and distress about the lumbar region, or the expulsion of sand, &c. announce that calculous

concretions exist, every measure must be adopted that is calculated to effect their expulsion, which will not at all interfere with means to be taken to prevent the formation of those substances in future, because the measures adapted to each, reciprocally favour each other.

The expulsion of gravelly particles is ordinarily attended with the least difficulty; the smallness of their bulk, the facility with which they are displaced by a small quantity of urine, the little obstacle afforded to their progress through the inequalities of the urinary passages, their resting suspended in the urine provided it be a little charged with mucus, &c. all concur to favour their evacuation; thus, it is sufficient, in the greater number of cases, to drink a certain quantity of aqueous liquids, or even pure water, to procure their expulsion with little difficulty.

Many patients obtain this advantage by drinking at different times during the day, particularly in the morning and

evening, either a large glass of pure water, or of some diuretic mineral water, such as Seltzer, Luxeuil, Contrexeville, &c. or a glass or two of table beer, or wine copiously diluted with water.

With this very simple precaution, several patients have continued to use a succulent diet, enjoy all the pleasures of the table, and in general expose themselves, in a manner, to all the causes which produce gravel, with impunity. — But there are many who are not so fortunate, and who should effect a restriction in their diet, and follow the general means already pointed out to diminish the quantity of uric acid.

If this method be not adopted, patients are constantly tormented by pains in the kidneys, rigors, general inquietude, and restlessness; and this state is often prolonged for many months. Some patients obtain temporary relief from the warm bath, the application of leeches, general bleeding, &c.: but the proper way to relieve, or what is still better, remove



these disorders, is the change of diet I have described.

But if patients do not adopt these salutary measures, gravel is not the only substance they void ; calculi are formed, and produce all the inconveniences attached to their progress through the urinary passages.

Some patients, who have been so fortunate as only to experience the formation of gravel, believe they are safe from stones in the kidneys and bladder, and all the serious accidents which result from the obstruction of the ureters by calculi ; and thence will not adopt any particular regimen. Their opinion is not well founded, and their security may be baneful to them : it is not rare to find calculi formed after gravel alone has existed for several years ; besides which, we have authenticated instances of patients whose ureters had become completely obstructed by an accumulation of sandy particles.

If it be of importance to favour the evacuation of gravel, we should, for more essential reasons, use every possible means

to procure the expulsion of calculi which may exist in the urinary passages: their bulk, their number, the irregular forms they sometimes assume, the roughness of their surface, &c., are so many causes which render their progress difficult, and oftèn occasion their retention.

We sometimes meet with patients who, for ten or fifteen years, or longer, void calculi periodically, and often of a considerable size, who suffer hardly any other inconvenience than a degree of uneasiness more or less marked along the urinary canal, at the time of the escape of the calculus. — These are privileged persons; their ureters, as well as the urethra, are probably of an extraordinary size; the stones they void are not of an irregular form; and above all, they have not that nervous sensibility which produces actual disease from slight causes of irritation.

Notwithstanding the calculi may pass out with the greatest facility, and without causing pain, it will be prudent to drink daily a certain quantity of aqueous

liquids, which render the urine more abundant ; for it may happen, that from neglecting to adopt this measure, a calculus may be arrested, and be productive of serious consequences.

Those patients who are in the state I have just mentioned, will derive much advantage from exercise on foot or on horseback, and in rather uneasy carriages ; the shaking they experience will favour the progress of the stones. These measures are, however, only applicable when the patient does not experience acute pains in the kidneys or ureters ; in those cases, the irritation they produce would be injurious.

It is to produce analogous effects that patients should be directed to take emetics from time to time. The powerful, long-continued pressure which the abdominal muscles exert on the viscera of the abdomen during the effort of vomiting, will, it is easy to conceive, contribute to the progress of the calculus towards the urethra. The employment of this measure will have another advantage, by



remedying the disordered state of the digestive organs, or dyspepsia, so frequently witnessed in persons affected with gravel.

All patients are far from enjoying this easy evacuation of calculi ; it is for the most part accompanied with the symptoms we have described in the foregoing pages ; — very acute pain in the kidneys and ureters, fever, rigors, restlessness, efforts to vomit, cramp in the legs, retraction of the testicles, frequent fruitless attempts to void the urine and go to stool, &c. and all these symptoms continue during the course of the calculus from the kidneys to the bladder. The physician, in these cases, must not only favour the escape of the stone by the means already described, but endeavour to alleviate the symptoms that may be produced, by all the measures adapted to that purpose.

The most rigorous diet, general bleeding, leeches, cupping with and without the scarificator, local and general baths, fumigations, and emollient fomentations,

are the principal means to be put in practice, adapting them with the utmost care to the severity of the disease, the age, the temperament, and the strength of the patient.

The use of these measures is ordinarily followed by complete success: after from twenty-four to thirty-six hours, the violence of the symptoms diminishes, the fever subsides, the pain is abated, the patient is disposed to sleep, and the urine freely voided carrying out with it one or more calculi. Sometimes, however, these symptoms are much more prolonged, during ten or fifteen days, for instance, and require a continuance of the use of the means I have just described.

It is of the greatest importance that the diminution or cessation of the symptoms should be accompanied with the expulsion of one or more stones from the bladder, for if this does not happen, we must expect that the same symptoms will be produced, and with increased violence.

Should no evacuation of calculous con-

cretions take place after the kind of paroxysm I have described, all the means should be put in force that are adapted to produce the expulsion of the retained calculus ; the diuretic drinks, baths, and the fomentations must be continued ; dry friction on the dorsal region and the abdomen, directed in such a manner as to favour the descent of the calculus through the ureter, may be joined with them ; exercise on foot and horseback, if the sensations of the patient will permit, should be advised : the shaking which accompanies these modes of exercise will aid the escape of the calculus.

Emetics should also be directed from the same intention ; we have frequently seen the use of them produce the evacuation of a calculus, where all the other measures had been tried in vain.

If the seat of pain seems to announce that the stone has passed the ureter, and is arrested at its inferior extremity, it will then be proper to endeavour by mechanical means to make it fall into the bladder. This result may be obtained,



either by passing a sound, or by the introduction of a finger into the anus, and thus conveying slight shocks to the fundus of the bladder.

The same means may be employed with success, if a calculus of a small size be engaged in some fold of the bladder and there retained.

Other modes of proceeding may be put in practice when a stone is fixed in the urethra; pressure carefully directed along the course of the urethra towards its extremity, oily and emollient injections into the canal, and, particularly, copiously drinking of watery liquids, are often sufficient to press forward the calculus. Sometimes it may be necessary to use surgical means for the immediate extraction of the stone.

Notwithstanding all these measures, calculi may be retained in the kidneys, ureters, or bladder, where they will increase in size by the addition of successive layers of uric acid, or the other salts contained in the urine: the physician has then to use all his efforts to prevent their increase, and even to procure their solution.

It will be so much the more important not to neglect these secondary curative indications, from the consideration, that although the urine may be in a healthy state, the presence merely of a foreign body in it produces a precipitation of the salts it holds in solution ; this is observed to take place on sounds that have remained in the bladder two or three days, which become covered with a layer, more or less thick, of saline matter.

These two indications may be at the same time effected : 1st, By placing the patient on a diet containing but little azote, to prevent the excess of uric acid in the urine (see chap. v.) ; 2dly, By producing an alkaline state of the urine by the internal use of the earthy and alkaline carbonates, and especially by the pure alkalies (see chap. vi.), diluted in a sufficient quantity of water.

If the calculi are formed of uric acid, the success of these means cannot be doubted, at least chemical and physiological reasoning will not permit us to con-

sider them as uncertain. Experiments have demonstrated, that a mass of uric acid being plunged into urine the acids of which have been saturated with potash or soda, with an excess of the alkali, at the temperature of from  $98^{\circ}$  to  $112^{\circ}$ , and frequently renewed, will at length be entirely dissolved.

This is not the case with the other urinary concretions, such as the ammoniaco-magnesian phosphates, the oxalate of lime, &c. but it has been already repeatedly stated, that these rarely form the lapidiform concretions of patients affected with gravel.

We have not yet, it is true, positive proof of the solution of a renal calculus ; but many cases have been witnessed of the disappearance of nephritic pains similar to those known to arise from calculi, by the use of alkaline medicines, in which cases the solution of the concretions may be considered as very probable. Lithon-  
triptics for the greater number of stones of the bladder doubtless do not exist,



for which it is easy to produce reasons ; but confining it to calculi of the kidneys and ureters formed of uric acid, the expectation of possessing such substances is not unreasonable. Nothing prevents the application of the same ideas to stones in the bladder when composed of uric acid ; it is much to be desired that the experiments relative to this subject were continued, and conducted in a manner which might exempt them from the character of vagueness in some degree peculiar to the researches of physicians.

To effect the object here proposed, that is, the solution of a renal calculus lodged in the pelvis of the kidney, or in the ureter, perseverance in the method of treatment will be necessary ; if the urine be not retained in an alkaline state for a considerable length of time, nothing can oppose the enlargement of these concretions.

Supposing even that there were no well-founded expectation of effecting the solution of calculi of uric acid lodged in

the pelvis of the kidneys or the ureters, it will not be the less adviseable to use the alkaline medicines ; for experience has long taught us that it is one of the most effectual means to relieve the pain and other symptoms of this disease.

## CHAP. X.

## ON THE EMPIRICAL TREATMENT OF GRAVEL.

WE are far from that period at which a correct theory shall explain all the phenomena of diseases, as well as the mode of conducting the curative measures; and if we shall ever arrive at that point, there will, without doubt, be a great revolution in the manner in which medicine has for many ages been cultivated. — In almost every instance, the wisest and best instructed physician can only act from an empiricism more or less uncertain, and if he employ a particular remedy, it is because he has derived good effects from it in analogous cases. It is for this reason, that in the treatment of gravel, a disease which may be explained to a certain point, even with respect to the action of remedies, we are often obliged to have recourse to means of which experience



has shewn us the efficacy, although theory cannot in any way account for it.

The greater number of patients, for example, derive benefit from the means proper to relieve the dyspepsia which often accompanies the disease; and among those means, magnesia in small doses, rhubarb, cinchona, and sulphurous waters, taken internally, are frequently attended with success. — I have seen repeated purgatives administered so as to produce considerable evacuations, have the most fortunate results. In this, as in many other respects, gravel somewhat resembles gout, rheumatism, dropsy, and other chronic maladies, which are often alleviated by the same measures. — In England, the medicine most in vogue to produce this effect, is the submuriate of mercury.

I have several times observed good effects result from cold baths, sulphurous baths, frictions, and even fumigations with steam or sulphur, in the way they have been administered for some years past in several establishments at Paris.

These sort of measures, all of which excite the actions of the skin, rendering the cutaneous perspiration more abundant, would appear, from theory, to be contrary to the indications for the treatment of gravel, and in the greater number of cases they produce ill effects, but they are very advantageous in other instances, where theory becomes silent in the presence of experience.

It is nearly the same with the sudden cure of gravel by a residence in the country for a time, by a change in the habits, occupations, moral affections, &c.; — no explanation of this phenomenon can at present be produced.

## CHAP. XI.

ON THE TREATMENT OF GRAVEL WHEN THE  
CONCRETIONS ARE NOT FORMED OF URIC  
ACID.

WE have said that in certain very rare cases of gravel the substances voided were composed of cystic oxide, oxalate of lime, or phosphate of lime. What should be the conduct of the physician when similar cases present themselves to him? Shall he confine himself to a trial of different empirical measures in succession, or will theory point out any advantageous mode of treatment?

Our ignorance of the causes which induce the formation of concretions of this kind, only permits us to form vague conjectures respecting the means proper to combat them.

The cystic oxide, however, being a substance which contains azote, is pro-



bably formed from the influence of causes analogous to those which produce uric acid ; besides which, this substance is soluble in alkalies and their carbonates. I should therefore not hesitate to place a patient affected with this species of gravel, under the treatment proper for the disease when it arises from uric acid. Experience alone can inform us of the results.

It has been proposed in the treatment of gravel formed of phosphate of lime, to employ the acids ; indeed, the urine in cases of this kind presents an excess of ammonia, which is probably the principal cause of the formation of the calculous concretions. Mr. Brande has related a case, in which carbonic acid appeared to produce advantageous results.

A person from whose bladder a large calculus entirely composed of phosphate, had been extracted, and whose stomach would not bear a powerful acid, took water charged with carbonic acid ; this agreed with him very well. On exa-

mining his urine it was found that he voided no more phosphate, except in a state of solution; after he had ceased to use the acid a short time, the phosphate again presented itself in the form of a white powder.

This fact proved that the use of carbonic acid was advantageous to the patient; but did it act in a manner which chemistry can explain, or was it merely an empirical measure? I should be more inclined to admit the latter explanation, because I have several times endeavoured to attack the phosphatic deposits from the urine, by the mineral and vegetable acids, and have never obtained any satisfactory result; it has indeed appeared to me, that the deposit has been increased by these means.

The most prudent conduct in the rare cases of gravel formed of phosphate of lime, is, in my opinion, to procure an abundant secretion of urine, so as to favour the solution of the salt; and to take other measures to relieve the state

of weakness and distress which almost always accompany this disease; these are the means that were most beneficial in two cases of this kind for which I was consulted.

Neither theory nor empiricism point out any thing relative to the treatment of those very rare cases, where the concretions are formed of oxalate of lime.

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